Intel® Celeron™ Processor Performance Brief

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EXECUTIVE SUMMARY: INTEL® CELERON™ PROCESSOR

The Intel® Celeron™ processor is Intel's proven platform for value-conscious buyers. It provides great performance at an exceptional value for business desktops, and makes an excellent choice for a first or additional household PC. Combining the advances of the Intel P6 architecture with the instruction set extensions of Intel MMX™ technology, the Celeron processor delivers quick and responsive performance for all of today's most popular applications. The Celeron processor represents genuine Intel quality, reliability, and compatibility from the world's leading microprocessor company.

Today's microprocessors are used to run a broad range of software applications. Multimedia, 3D, and Internet application use has increased sharply over the past few years, and this trend is anticipated to continue in the future. For this reason, a wide range of benchmarks should be considered when evaluating processor and system performance. PC users and buyers should consider the entire Spectrum of Performance, which includes productivity, multimedia, 3D, and Internet performance.

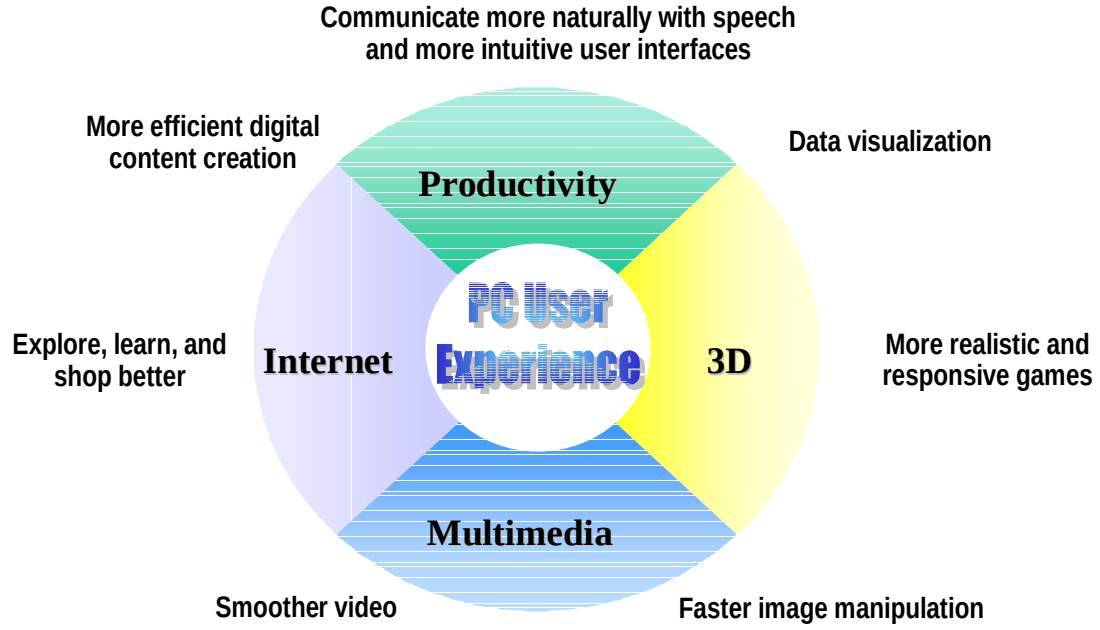

Figure 1. The Spectrum of Performance

This Performance Brief examines the purpose and methods behind the industry's most useful benchmarks, provides the latest benchmark results for the Intel Celeron processor across the Spectrum of Performance, and explains the technologies that enable the Celeron processor to achieve these results.

CONTENTS

FIGURES

TABLES

INTRODUCTION

The Celeron processor delivers great performance at an exceptional value for desktop systems, combining the power of Intel P6 architecture with the capabilities of Intel MMX technology in a low-cost form factor that can be easily deployed in existing Intel architecture computing environments. This brief provides performance results for the following desktop Celeron processors:

- Celeron processor at 466 MHz
- Celeron processor at 433 MHz
- Celeron processor at 400 MHz
- Celeron processor at 366 MHz
- Celeron processor at 333 MHz
- Celeron processor at 300A MHz

In any evaluation of performance, it is important to understand how the microprocessor and its host system execute various tasks. Today's PC user runs a broad spectrum of productivity, 3D, multimedia, and Internet software:

- Productivity software includes applications such as word processing, presentation, and personal finance programs.

- Multimedia software includes audio, video, imaging, and creativity applications.

- 3D software includes gaming, modeling, and simulation applications.

- Internet applications include Internet browsers, as well as 3D and multimedia Web content.

A processor and system should deliver high performance across the entire Spectrum of Performance: Productivity, Multimedia, 3D, and Internet.

This report provides benchmark results for the Intel Celeron processor family. Modern, industry-standard benchmarks were chosen to demonstrate capabilities across the Spectrum of Performance:

- Productivity performance can be measured using processor-level productivity benchmarks such as Ziff-Davis'* CPUmark* 99 and system-level benchmarks such as BAPCO's SYSmark* 98.

- Multimedia performance can be compared using Futuremark's* MultimediaMark* 99 benchmark.

- 3D performance can be measured with the 3D Winbench* 99–3D Lighting and Transformation test, 3DMark* 99 MAX–Synthetic CPU 3D Speed Test from Futuremark, and floating-point benchmarks such as Ziff-Davis' WinBench* 99–FPU WinMark*.

- Java aspects of the Internet experience can be measured by the Ziff-Davis JMark* 2.0 processor test.

Intel is committed to using the most robust and relevant benchmarks in characterizing the performance of its products, and will adapt this mix over time as newer benchmarks are introduced into the PC market.

System performance does not depend on the microprocessor alone. Hardware and software system components—such as the operating system, the graphics and I/O subsystems, application software, and memory—may significantly affect benchmark results. For this reason, this Performance Brief illustrates Celeron processor performance on a consistent system configuration. Details of the system configuration used for the benchmarks throughout this brief can be found in Appendix A.

SPECTRUM OF PERFORMANCE

When evaluating the performance of a microprocessor or system, it is important to obtain the complete performance picture. A processor and system should deliver high performance across the entire Spectrum of Performance: Productivity, Multimedia, 3D, and Internet.

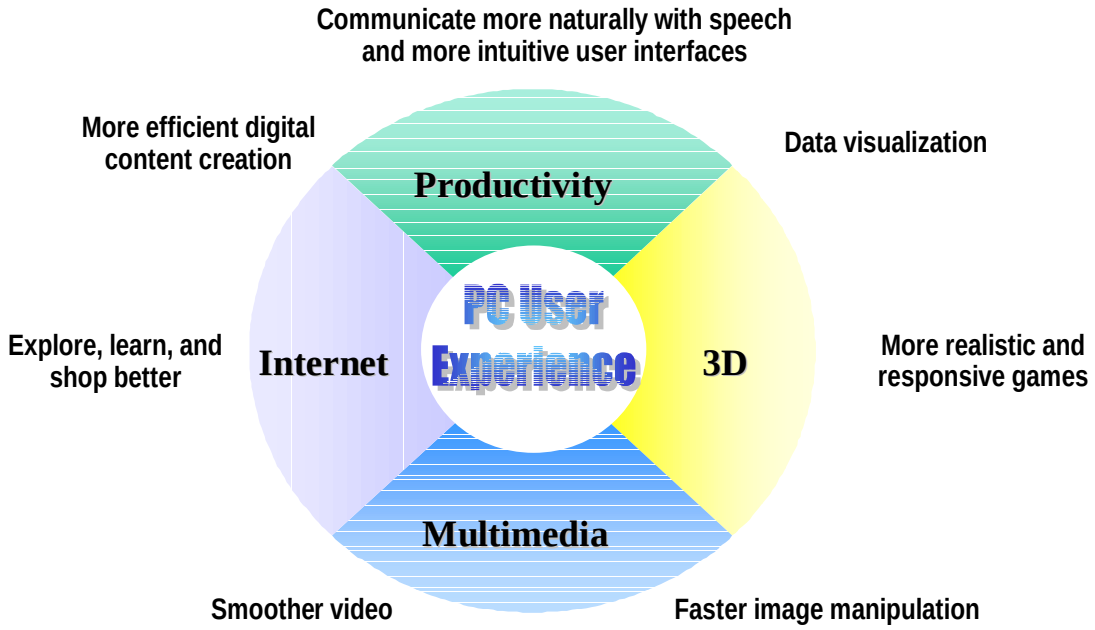

Figure 2. The Spectrum of Performance

Productivity Benchmarks

Productivity software includes applications such as word processing, presentation, and personal finance. Popular, industry-standard productivity benchmarks include:

Processor Level Benchmarks:

- CPUmark 99
- Wintune* 98 Advanced CPU Integer Test
- SPECint*95

System Level Benchmarks:

- SYSmark 98
- High End Winstone* 99
- Business Winstone 99

Multimedia Benchmarks

Multimedia benchmarks are designed specifically to represent the activities of end users employing video, audio, and imaging technologies such as MPEG-1*, Dolby* Digital Sound, AVI, PC imaging, and video conferencing. A benchmark that falls under this category is:

- MultimediaMark 99

3D Benchmarks/Floating-Point Benchmarks

The most common type of 3D application today is 3D games. Benchmarks that measure processor 3D and floating point performance include:

- 3D Winbench 99–3D Lighting and Transformation Test
- Futuremark 3DMark 99 MAX–Synthetic CPU 3D Speed Test
- WinBench 99–FPU WinMark
- SPECfp95*

Internet Technology Benchmarks

Internet applications are evolving at a tremendous rate and include browser, 3D, and multimedia technologies. In attempting to evaluate processor Internet performance, PC users should consult the productivity, 3D, and multimedia benchmarks listed above. Additionally, some Java Internet technology benchmarks are:

Processor Level Benchmarks:

- JMark 2.0 Processor Test

System Level Benchmarks:

- SYSmark J

THE INTEL® CELERON™ PROCESSOR

The Intel Celeron processor is Intel's proven platform for value-priced business desktops and home PCs. It combines the advances of the Intel P6 architecture with the instruction set extensions of Intel MMX technology to deliver quick and responsive performance for today's most popular operating systems and applications.

In all its available speeds—including the newest processor at 466 MHz—the Celeron processor delivers Intel quality, reliability, and compatibility. Based on Intel's advanced 0.25 micron CMOS process technology, the processor core and integrated level 2 128K cache of the 466, 433, 400, 366, 333 and 300A MHz Celeron processors contain approximately 19 million transistors.

Celeron processors at 466, 433, 400, 366, 333, and 300A MHz are available in a plastic pin grid array (P.P.G.A.) form factor. P.P.G.A. is compatible with the 370-pin socket and provides an opportunity for OEMs to introduce new system designs while lowering manufacturing costs.

The Celeron processor is backed by over 25 years of Intel experience in manufacturing high-quality, reliable microprocessors.

INTEL® CELERON™ PROCESSOR PRODUCT FEATURE HIGHLIGHTS

The Intel Celeron processor is fully compatible with an entire library of PC software based on operating systems such as MS-DOS*, Windows* 3.1, Windows for Workgroups* 3.11, Windows 98, Windows 95, OS/2*, UnixWare*, SCO UNIX*, Windows NT, OPENSTEP*, and Sun Solaris*. Architectural features of the Celeron processor include:

- Dynamic Execution Technology:

  ⇒ Dynamic execution incorporates the concepts of out of order and speculative execution. The Celeron processor's implementation of these concepts removes the constraint of linear instruction sequencing between the traditional fetch and execute phases of instruction execution. Up to 3 instructions can be decoded per clock cycle. These decoded instructions are put into a buffer, which can hold up to 40 instructions. Instructions are executed from this buffer when their operands are available (versus instruction order). Up to 4 instructions can be executed per clock cycle.

- Superpipelining:

  ⇒ The pipeline of the P6 architecture consists of approximately 12 stages versus 5 for the Pentium processor and 6 for the Pentium processor with MMX technology. This enables the Celeron processor to achieve about a 50% higher frequency than the Pentium processor on the same manufacturing technology. The sophisticated, two-level, adaptive-training, branch prediction mechanism of the P6 microarchitecture is the key to maintaining the efficiency of the Intel Celeron processor's superpipelined microarchitecture.

- High Performance Intel MMX Technology:

  ⇒ Intel's MMX technology is a major enhancement to the Intel Architecture that enables PCs to provide richer multimedia and communications capabilities. This technology introduces 57 instructions oriented to highly parallel operations with multimedia and communications data types. These instructions use a technique known as SIMD (Single Instruction, Multiple Data) to deliver better performance for multimedia and communications computation. Intel processors that include MMX technology are fully compatible with previous generations of the Intel Architecture and the installed base of software.

  ⇒ The Celeron processor, like the Pentium II processor, can execute 2 Intel MMX instructions simultaneously.

- Write Combining:

  ⇒ The Write Combining technology of the P6 architecture can be used to achieve very high graphics I/O performance. This feature combines multiple writes to a region of memory (for example, a video controller's frame buffer) declared as WC type into a single burst write operation. This is well suited for the bus, which is optimized for burst transfers. These writes are further combined by the chipset, leading to high throughput for graphics I/O. This further enhances multimedia performance and enables more realistic full-motion video and fast, realistic graphics performance.

- Caches:

  ⇒ The Celeron processor has 32K of non-blocking L1 cache, which is divided into a 16K instruction cache and a 16K data cache. Each of these caches runs at the processor frequency and provides fast access to heavily used data.

  ⇒ The 466, 433, 400, 366, 333, and 300A MHz Celeron processors have a 128K full-speed L2 cache that is unified for code and data, and is non-blocking. A dedicated 64-bit bus facilitates higher data transfer rates between the processor and the L2 cache.

- Floating-Point Pipeline:

  ⇒ A pipelined Floating-Point Unit (FPU) supports the 32-bit and 64-bit IEEE* 754 formats as well as the 80-bit format. The FPU is object code-compatible with the Pentium and i486™ processor FPUs.

- Testing and Performance Monitoring Features:

  ⇒ Built In Self Test (BIST) provides single stuck-at fault coverage of the microcode and large PLAs, as well as testing of the instruction cache, data cache, Translation Lookaside Buffers (TLBs) and ROMs.

  ⇒ IEEE 1149.1 Standard Test Access Port and Boundary Scan Architecture mechanism allows testing of the Celeron processor through a standard interface.

  ⇒ Internal performance counters can be used for performance monitoring and event counting.

MICROPROCESSOR PERFORMANCE SUMMARY

Productivity Benchmarks

CPUmark* 99

Ziff-Davis' CPUmark 99 is a Windows benchmark that measures the performance of a PC processor, its internal cache (both level one and/or level two), external cache, and system RAM.

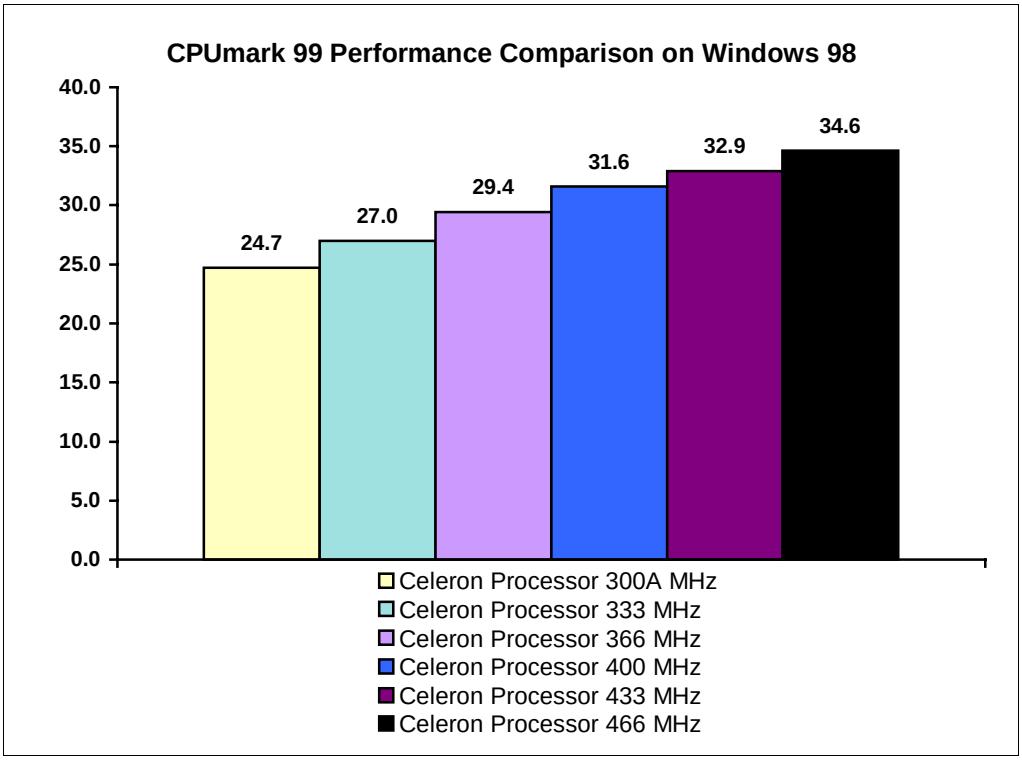

Figure 3. Intel Celeron Processor Performance for the Ziff-Davis CPUmark 99 Benchmark

Wintune* 98 Advanced CPU Integer Test

Wintune 98 is a diagnostic testing and benchmark program for Windows 98, Windows 95, and Windows NT systems. It performs a series of seven tests, including CPU, memory, video, and disk speed tests. Test results can be compared to results from similar machines through a central database maintained by Windows Magazine on the Internet.

The Wintune 98 Advanced CPU Integer test concentrates on the productivity performance of the CPU. In addition, this test stresses the CPU memory cache to reflect the performance of real-world applications. Results of this test are most applicable to word processing, spreadsheet, and other productivity applications.

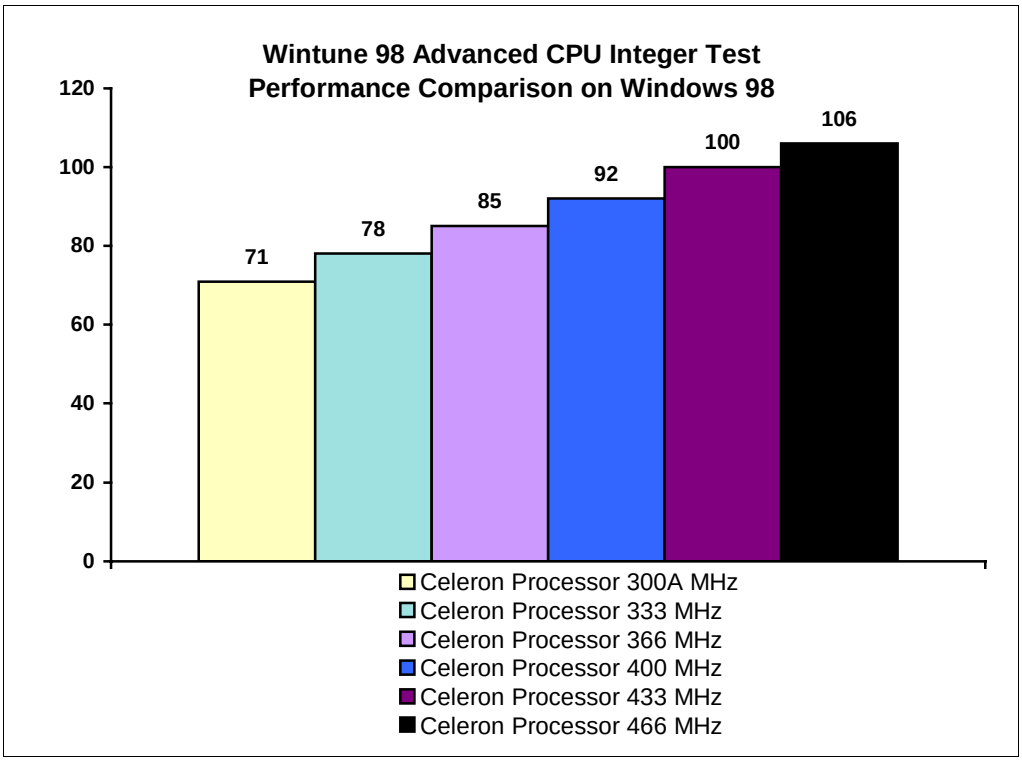

Figure 4. Intel Celeron Processor Performance for the Wintune 98 Advanced CPU Integer Test

SPECint*95

SPEC CPU95 is a software benchmark product that can be run on Windows NT and many varieties of UNIX. SPEC CPU95 is produced by Standard Performance Evaluation Corp. (SPEC), a non-profit group of computer vendors, system integrators, universities, research organizations, publishers, and consultants throughout the world. It was designed to provide comparisons of performance for compute-intensive workloads on different computer systems.

SPEC CPU95 consists of two suites of benchmarks: SPECint95 for measuring and comparing compute-intensive integer performance, and SPECfp95 for measuring and comparing compute-intensive floating-point performance. The two suites provide component-level benchmarks that measure the performance of the computer's processor, memory architecture, and compiler. SPEC benchmarks are selected from existing application and benchmark source code running across multiple platforms.

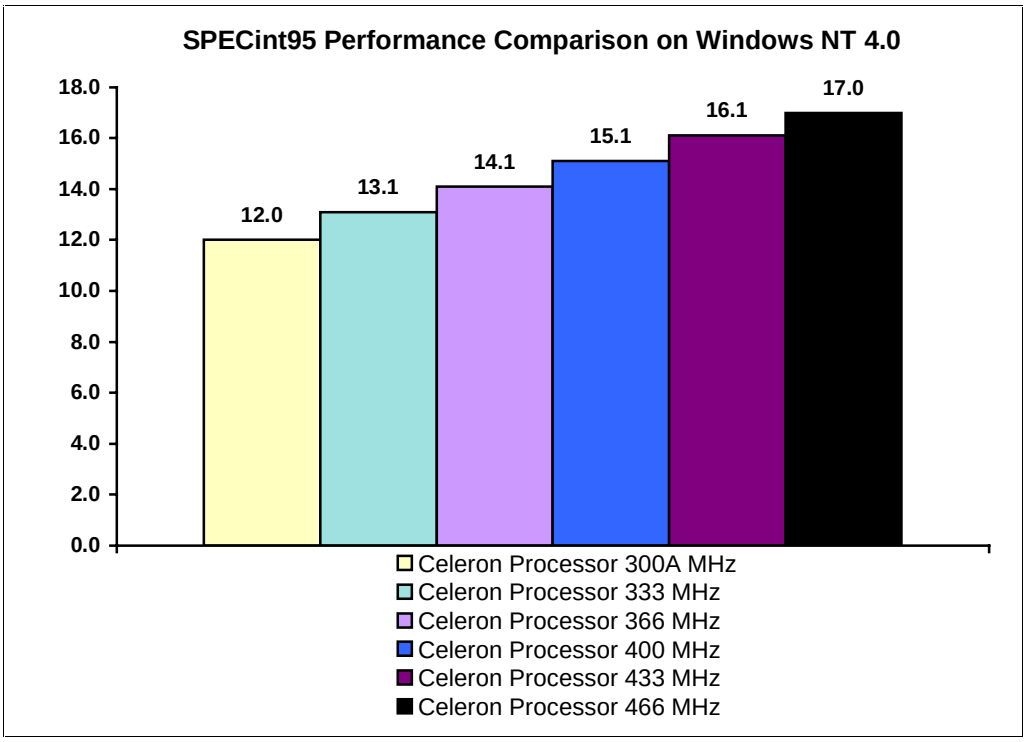

Figure 5. Intel Celeron Processor Performance for the SPECint95 Benchmark

SYSmark* 98 For Windows 98 and NT 4.0

SYSmark 98 for Windows 98 and NT 4.0 is a suite of application software and associated benchmark scripts developed by Business Applications Performance Corporation (BAPCO), a non-profit consortium of PC OEMs, software vendors, semiconductor manufacturers, and industry publications. SYSmark 98 is a tool that measures system performance on popular business-oriented applications in the Microsoft* Windows operating environment. The scripts were developed to reflect usage patterns of PC users in a business-oriented environment.

SYSmark 98 includes 32-bit benchmark scripts for the following categories and applications:

Office Productivity:
- Corel* CorelDRAW* 8
- Microsoft Excel* 97
- Dragon Systems* Naturally Speaking* 2.02
- Netscape* Communicator* 4.05
- Caere* OmniPage Pro* 8.0
- Corel Paradox* 8.0
- Microsoft PowerPoint* 97
- Microsoft Word* 97

Content Creation:
- MetaCreations* Bryce* 2
- Avid* Elastic Reality* 3.1
- Macromedia* Extreme3D* 2
- Adobe* Photoshop* 4.0.1
- Adobe Premiere* 4.2
- Xing Technology* XingMPEG* Encoder* 2.1

Figure 6 and Figure 7 illustrate the SYSmark 98 rating under Windows 98 and Windows NT 4.0 for the Celeron processor.

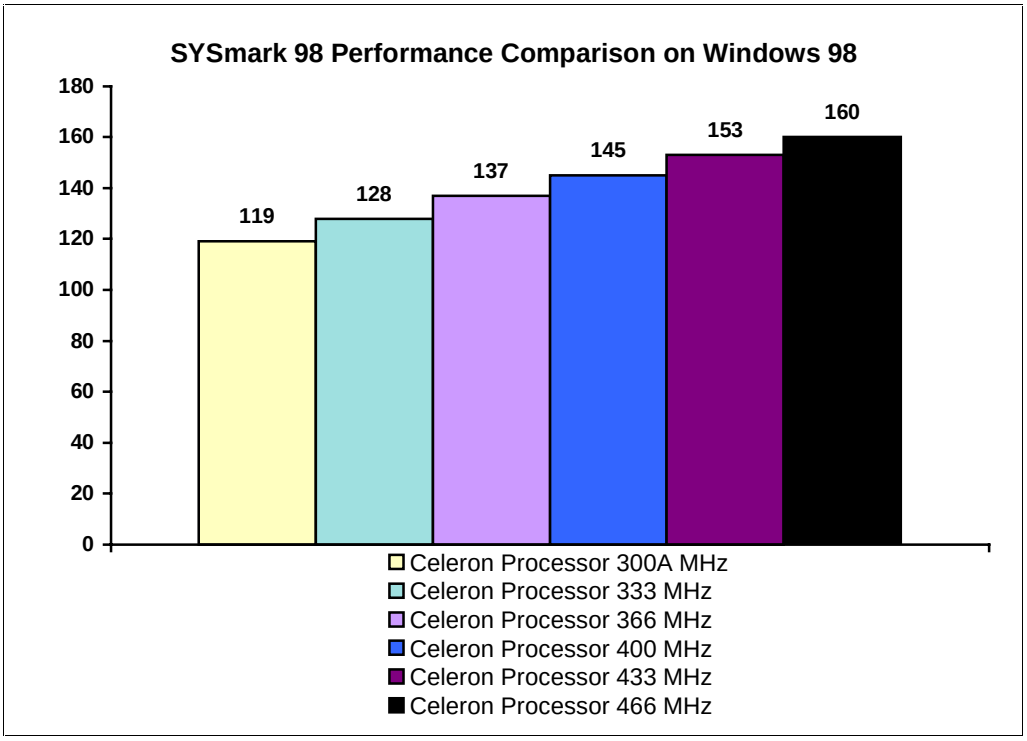

Figure 6. Intel Celeron Processor Performance for SYSmark 98 on Windows 98

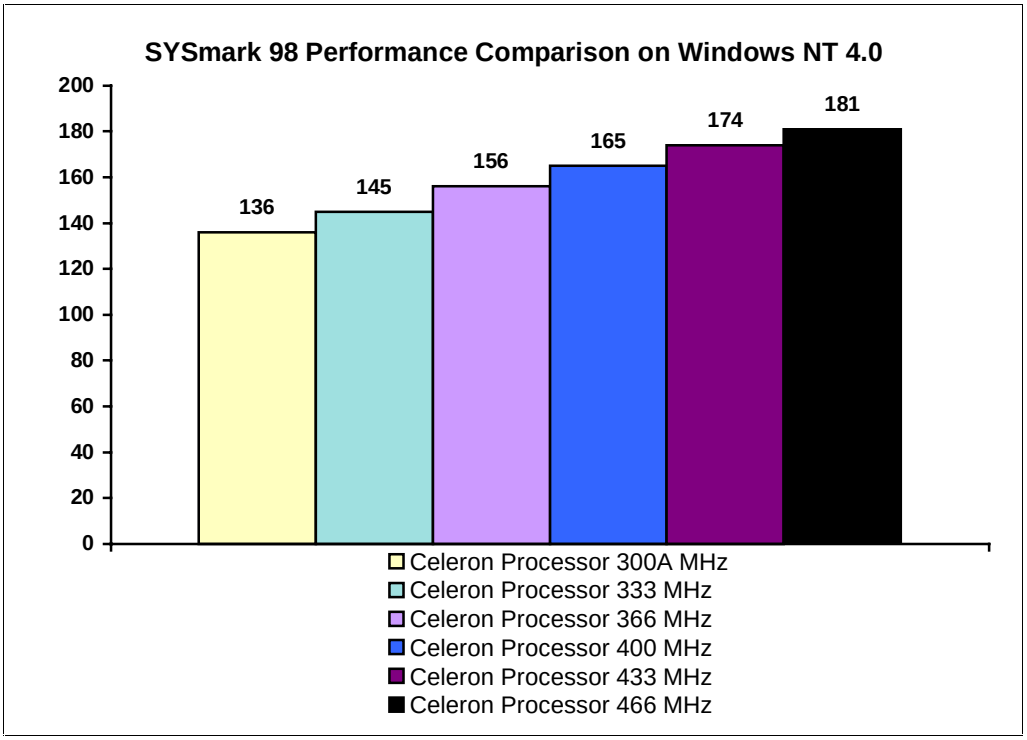

Figure 7. Intel Celeron Processor Performance for SYSmark 98 on Windows NT 4.0

Winstone* 99

Winstone 99 is a system-level, application-based benchmark developed by Ziff-Davis. Winstone 99 measures a PC's overall performance when running Windows-based 32-bit applications on Windows 98 or Windows NT 4.0. It runs actual 32-bit business suites through a series of scripted activities and uses the time a PC takes to complete those activities to produce its performance scores.

Business Winstone 99 incorporates the following popular office software suites: Corel WordPerfect* Suite 8, Lotus* SmartSuite*, and Microsoft Office* 97. To mirror the typical usage patterns of today's PC users, the benchmark keeps multiple applications open within each suite, and switches tasks between these applications and the Netscape Navigator* Internet browser.

Unlike Business Winstone 99, the applications in High End Winstone 99 are not grouped into suites. This benchmark includes the following applications: Adobe Photoshop 4, Adobe Premiere 4.2, AVS/Express* 3.4, Microsoft FrontPage* 98, Microsoft Visual C++* 5.0, Sound Forge* 4.0 and MicroStation* SE.

Figure 8 and Figure 9 illustrate the results for High End Winstone 99 for Windows NT 4.0 and Business Winstone 99 for Windows 98, respectively.

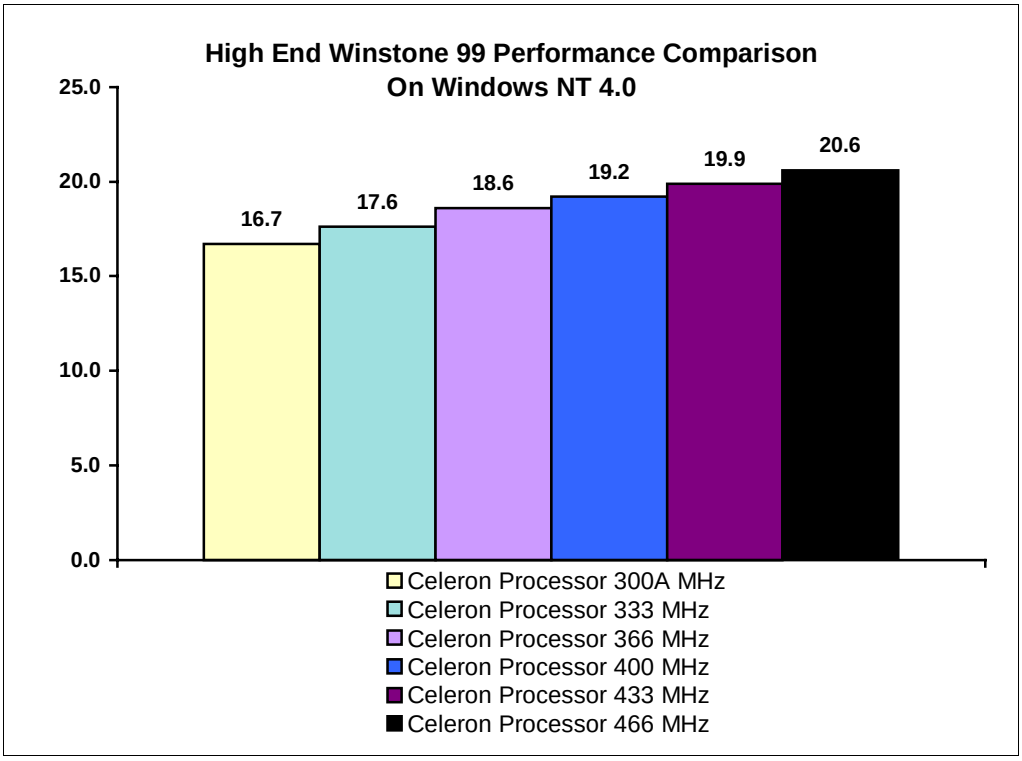

Figure 8. Intel Celeron Processor Performance for the High End Winstone 99 Benchmark

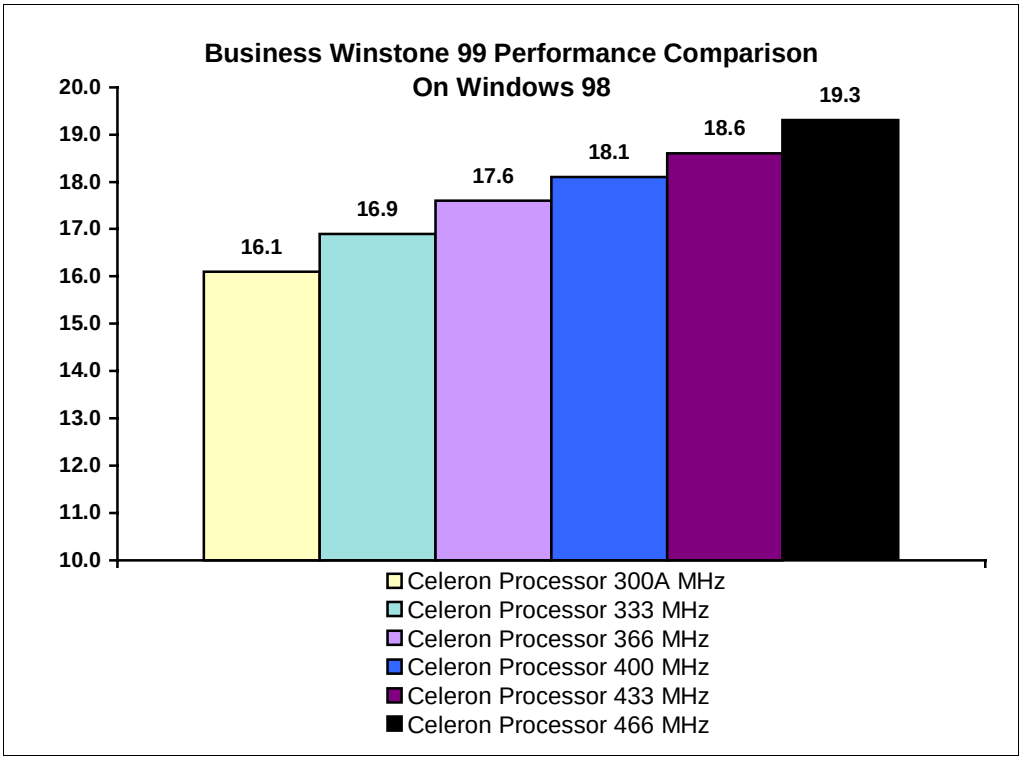

Figure 9. Intel Celeron Processor Performance for the Business Winstone 99 Benchmark

Multimedia Benchmarks

MultimediaMark* 99

MultimediaMark 99 is a benchmark application suite by Futuremark Corporation. It focuses on testing multimedia performance of a modern PC in a “real world” environment. The components of MultimediaMark 99 include MPEG-1 video encoding, MPEG-1 video playback, image processing, and audio effects.

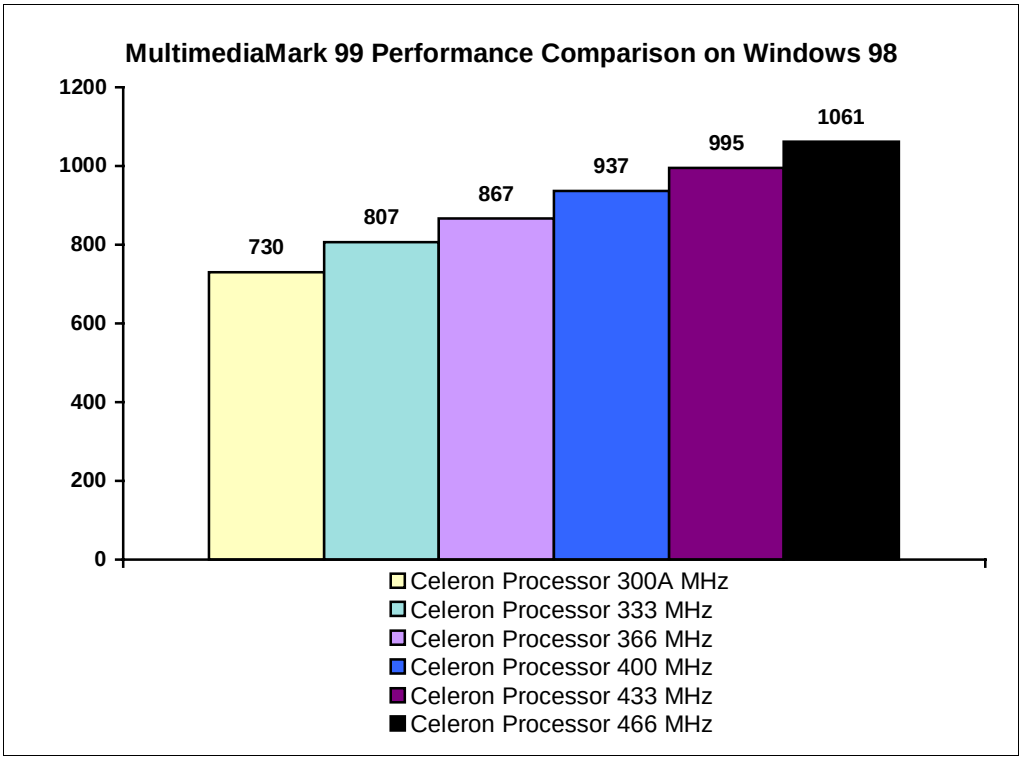

Figure 10. Intel Celeron Processor Performance for the MultimediaMark 99 Benchmark

3D Benchmarks/Floating-Point Benchmarks

3D Winbench* 99–3D Lighting and Transformation Test

3D Winbench 99 measures system-level 3D performance including CPU and graphics subsystem performance. To understand the processor 3D performance, the benchmark suite includes the 3D Winbench 99–3D Lighting and Transformation test. This benchmark measures the CPU-intensive portion of the 3D graphics pipeline.

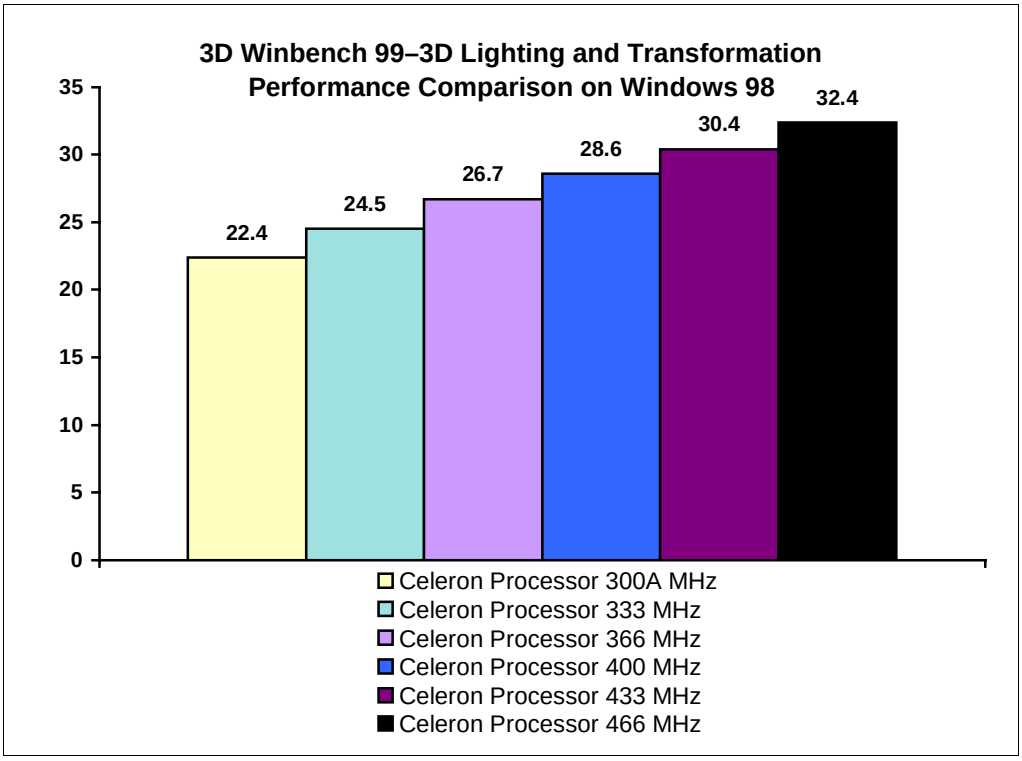

Figure 11. Intel Celeron Processor Performance for the 3D Winbench 99–3D Lighting and Transformation Test

3DMark* 99 MAX–Synthetic CPU 3D Speed Test

3DMark 99 MAX from Futuremark is a diagnostic suite of benchmarks, based on current 3D games and high-end applications, that analyzes, tests, and reports on a system's 3D performance. For processor comparisons, 3DMark 99 MAX includes the Synthetic CPU 3D Speed Test. This test focuses on the floating-point intensive 3D geometry portion of the graphics pipeline.

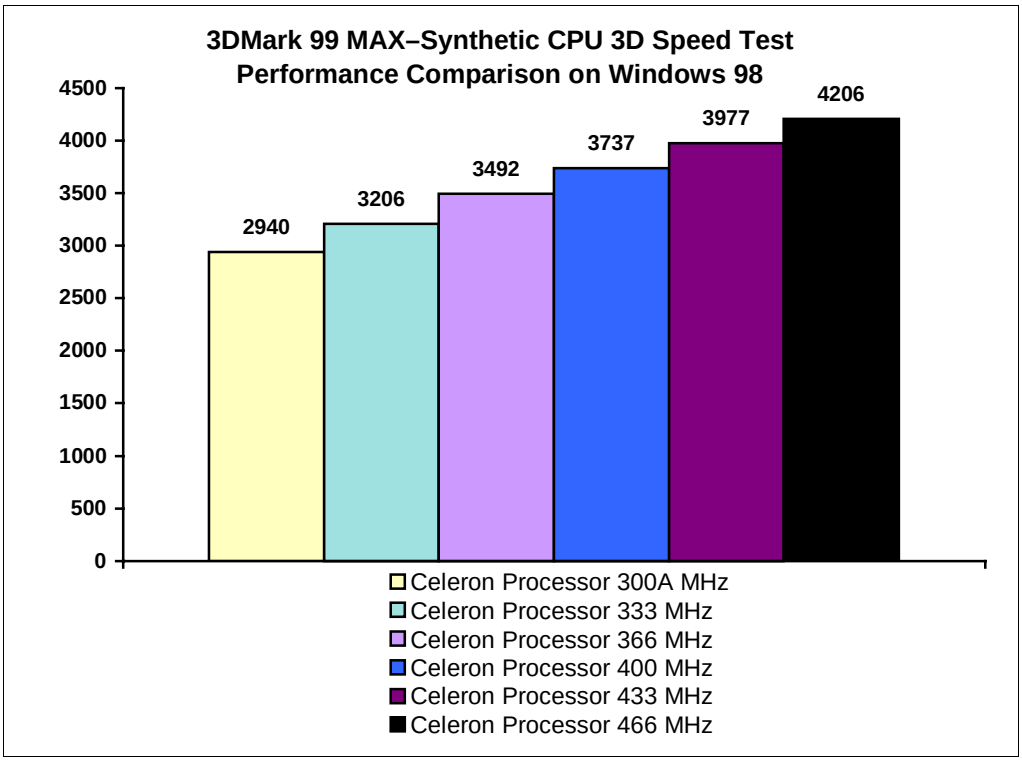

Figure 12. Intel Celeron Processor Performance for the 3DMark 99 MAX–Synthetic CPU 3D Speed Test

WinBench* 99–FPU WinMark*

The WinBench 99–FPU WinMark benchmark measures the performance of the processor floating-point subsystem, which is used for tasks such as 3D graphics rendering and scientific calculations. This synthetic benchmark was developed by Ziff-Davis. The test consists of five algorithms: 3D graphics operations, fast Fourier transforms (FFT), calculation of planetary orbitals, calculation of areas of polygons, and Gauss-Jordan elimination of a coefficient matrix of linear equations. The benchmark reports a single score based on the weightings that Ziff-Davis has assigned to the component algorithms.

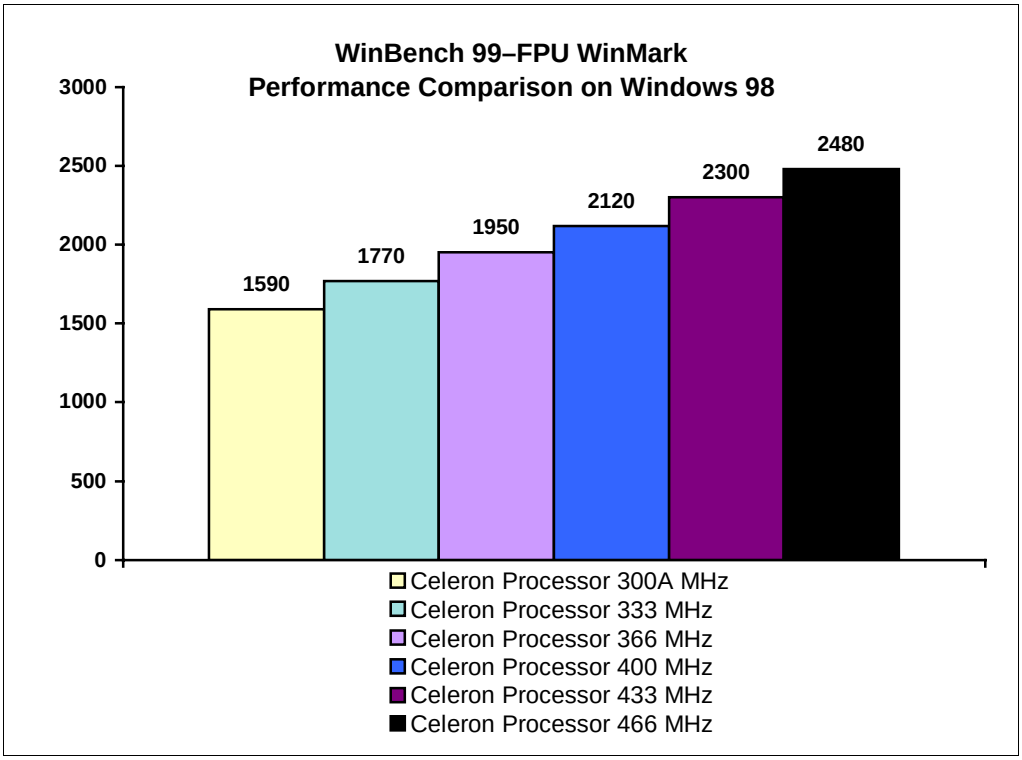

Figure 13. Intel Celeron Processor Performance for the WinBench 99–FPU WinMark Benchmark

SPECfp*95

SPEC CPU95 is a software benchmark product that can be run on Windows NT and many varieties of UNIX. SPEC CPU95 is produced by the Standard Performance Evaluation Corp. (SPEC), a non-profit group of computer vendors, system integrators, universities, research organizations, publishers, and consultants throughout the world. It was designed to provide measures of performance for comparing compute-intensive workloads on different computer systems.

SPEC CPU95 consists of two suites of benchmarks: SPECint95 for measuring and comparing compute-intensive integer performance, and SPECfp95 for measuring and comparing compute-intensive floating-point performance. The two suites provide component-level benchmarks that measure the performance of the computer's processor, memory architecture, and compiler. SPEC benchmarks are selected from existing application and benchmark source code running across multiple platforms.

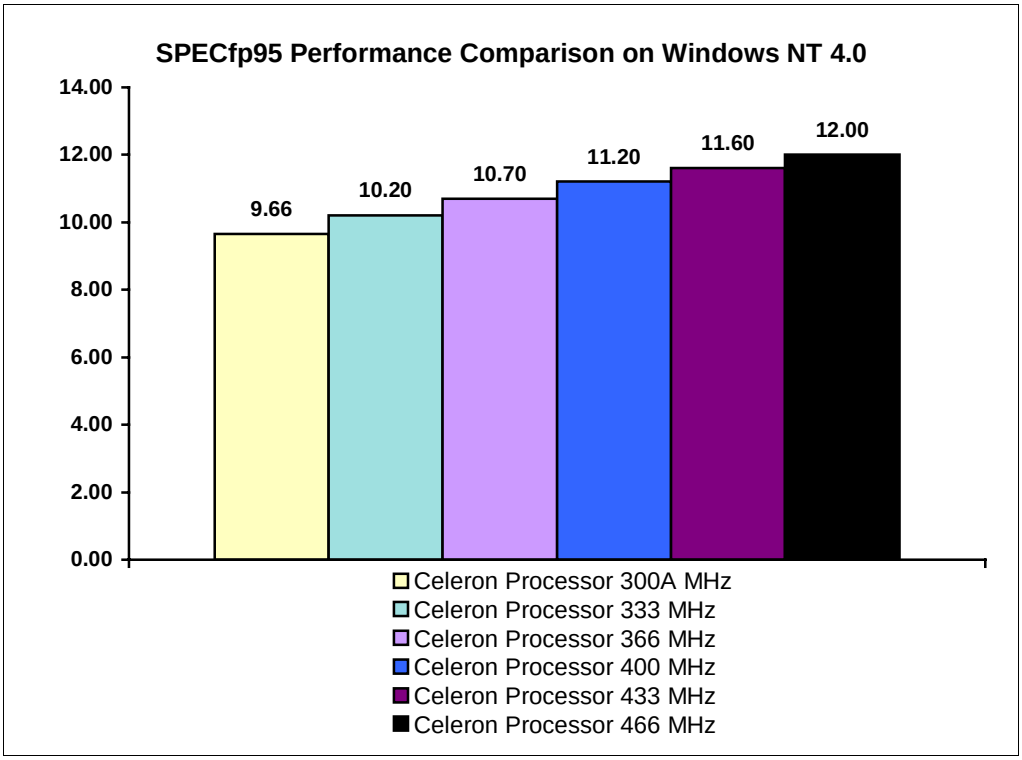

Figure 14. Intel Celeron Processor Performance for the SPECfp95 Benchmark

Internet Technology Benchmarks

JMark* 2.0 Processor Test

JMark 2.0 is a benchmark developed by Ziff-Davis to measure processor Java performance. The JMark 2.0 Processor Test stresses the Java Virtual Machine (JVM) on a non-graphical workload.

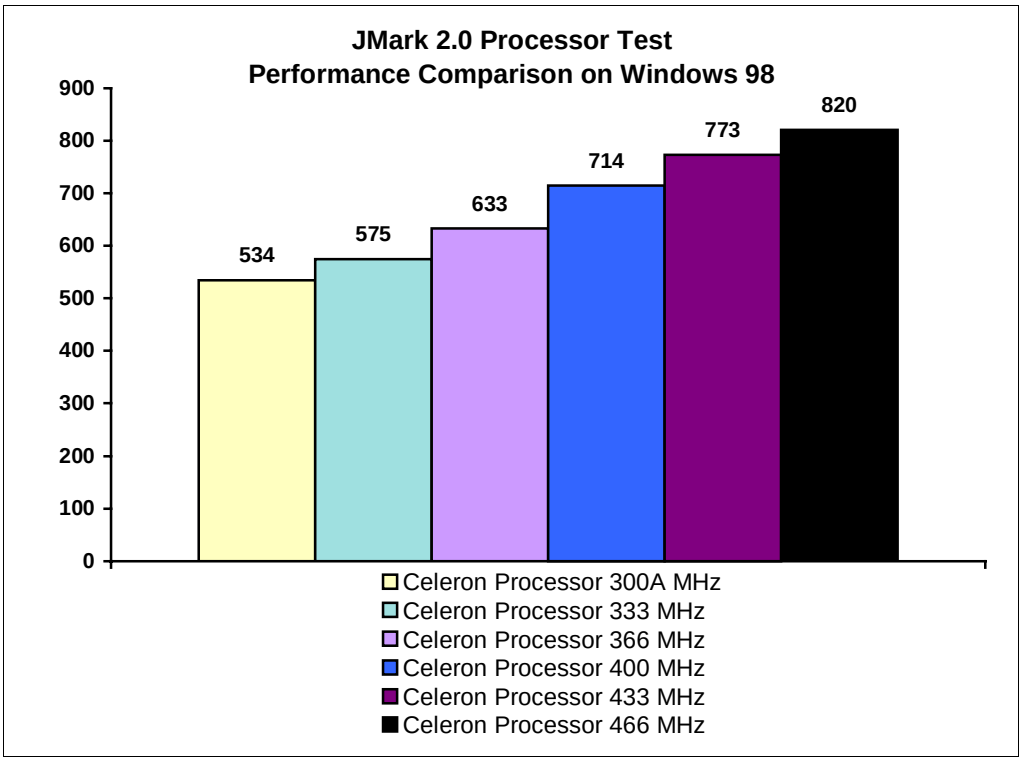

Figure 15. Intel Celeron Processor Performance for the Ziff-Davis JMark 2.0 Processor Test

SYSmark* J

SYSmark J is a Java benchmark suite designed and developed by the Business Applications Performance Corporation (BAPCO). It allows performance comparisons across platforms that support Java Development Kit Version 1.1 (JDK1.1). SYSmark J is a collection of 4 applications covering word processing, spreadsheet, image processing, and multimedia.

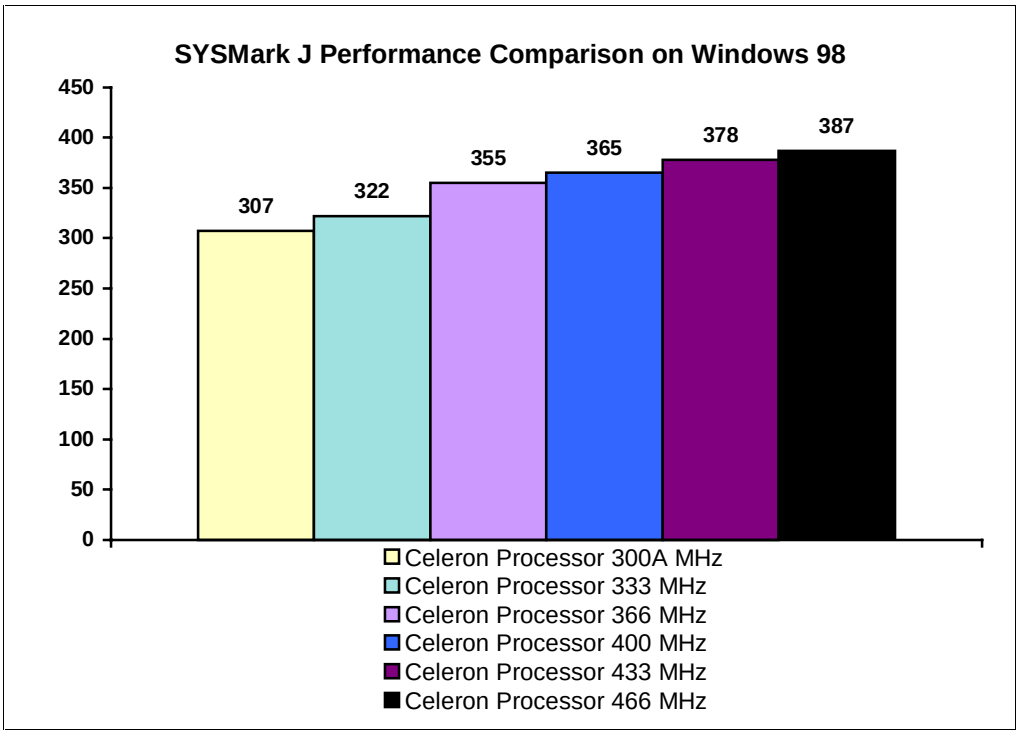

Figure 16. Intel Celeron Processor Performance for SYSmark J for Windows 98

SUMMARY

Table 1 summarizes productivity benchmark performance for the Intel Celeron processor. A higher score indicates better performance.

Table 1. Spectrum of Performance Benchmark Results—Productivity Benchmarks

	Celeron processor 466 MHz	Celeron processor 433 MHz	Celeron processor 400 MHz	Celeron processor 366 MHz	Celeron processor 333 MHz	Celeron processor 300A MHz
SYSmark 98—Win98	160	153	145	137	128	119
Business Winstone 99—Win98	19.3	18.6	18.1	17.6	16.9	16.1
SYSmark98—NT 4.0	181	174	165	156	145	136
Business Winstone 99—NT 4.0	25.1	24.4	23.7	22.9	21.9	21.0
High End Winstone 99—NT 4.0	20.6	19.9	19.2	18.6	17.6	16.7
CPUmark 99—Win98	34.6	32.9	31.6	29.4	27.0	24.7
Wintune 98 Advanced CPU Integer Test—Win98	106	100	92	85	78	71
SPECint95—NT 4.0	17.00	16.10	15.10	14.10	13.10	12.00

Table 2 summarizes multimedia benchmark performance for the Intel Celeron processor. A higher score indicates better performance.

Table 2. Spectrum of Performance Benchmark Results—Multimedia Benchmarks

	Celeron processor 466 MHz	Celeron processor 433 MHz	Celeron processor 400 MHz	Celeron processor 366 MHz	Celeron processor 333 MHz	Celeron processor 300A MHz
MultimediaMark 99—Win98	1061	995	937	867	807	730

Table 3 summarizes 3D/floating-point benchmark performance for the Intel Celeron processor. A higher score indicates better performance.

Table 3. Spectrum of Performance Benchmark Results—3D Benchmarks/Floating-Point Benchmarks

	Celeron processor 466 MHz	Celeron processor 433 MHz	Celeron processor 400 MHz	Celeron processor 366 MHz	Celeron processor 333 MHz	Celeron processor 300A MHz
3D Winbench 99–3D Lighting and Transformation—Win98	32.4	30.4	28.6	26.7	24.5	22.4
WinBench 99–FPU WinMark—Win98	2480	2300	2120	1950	1770	1590
3DMark 99 MAX–Synthetic CPU 3D Speed Test—Win98	4206	3977	3737	3492	3206	2940
SPECfp_base95—NT 4.0	11.30	11.00	10.50	10.10	9.58	9.00
SPECfp95—NT 4.0	12.00	11.60	11.20	10.70	10.20	9.66

Table 4 summarizes Internet benchmark performance for the Intel Celeron processor. A higher score indicates better performance.

Table 4. Spectrum of Performance Benchmark Results—Internet Technology Benchmarks

	Celeron processor 466 MHz	Celeron processor 433 MHz	Celeron processor 400 MHz	Celeron processor 366 MHz	Celeron processor 333 MHz	Celeron processor 300A MHz
Jmark 2.0 Processor Test—Win98	820	773	714	633	575	534
SYSmark J—Win98	387	378	365	355	322	307

APPENDIX A — TEST CONFIGURATIONS

Table 5. System Configuration Used in Benchmark Tests

Processor	**Celeron Processor 466 MHz. 433 MHz, 400 MHz, 366 MHz, 333 MHz, 300A MHz**
System	Intel Bimini 440ZX BI440ZX motherboard with BIOS Version 4B4IZ0XA.86A.0008.P05999
FPU	Integrated
Primary Cache	32KB L1 cache (16KB I + 16KB D)
Secondary Cache	128KB L2 cache
Chipset	Intel 82440 ZX AGPset
Memory Size and Type	64 MB SDRAM DIMM 66MHz
Hard Disk Controller/Bus	Integrated EIDE/PCI
Hard Disk	Seagate Medalist Pro ST34520A 7200 RPM UDMA33 EIDE
2D/3D Graphics Adapter	Diamond Viper* v330 (nVidia Riva 128) AGP with 4MB memory
CD ROM Drive	Toshiba* XM-6302B 32X EIDE
Sound Card	Creative Labs Sound Blaster* 16 ISA PnP
SPEC CPU95 Compiler	Intel C Compiler Plug-In 4.0 (for libraries: Microsoft Visual C/C++ 6.0); Intel FORTRAN Compiler Plug-In 2.4
Operating System 1	**Windows 98 build 4.10.1998.** FAT32 partition, 32-bit File System, MS DirectX* 6.0 build 4.06.0138 (except DirectX 6.1 build 4.06.02.0436 for 3DMark 99 MAX benchmark)
Graphics Driver Revision	v4.10.01.0128 driver for Windows 98
Graphics	1024x768 resolution, 16-bit color (except 800x600 resolution, 16-bit color for 3DMark 99 MAX benchmark)
Operating System 2	**Windows NT 4.0 build 1381.** FAT16 partition with Service Pack 3 (and NTFS partition for SPEC CPU95 benchmark)
Graphics Driver Revision	v4.00.1381.0228.4.0.0 driver for Windows NT 4.0 with NT Service Pack 3 installed
Graphics	1024x768 resolution, 16 bit color